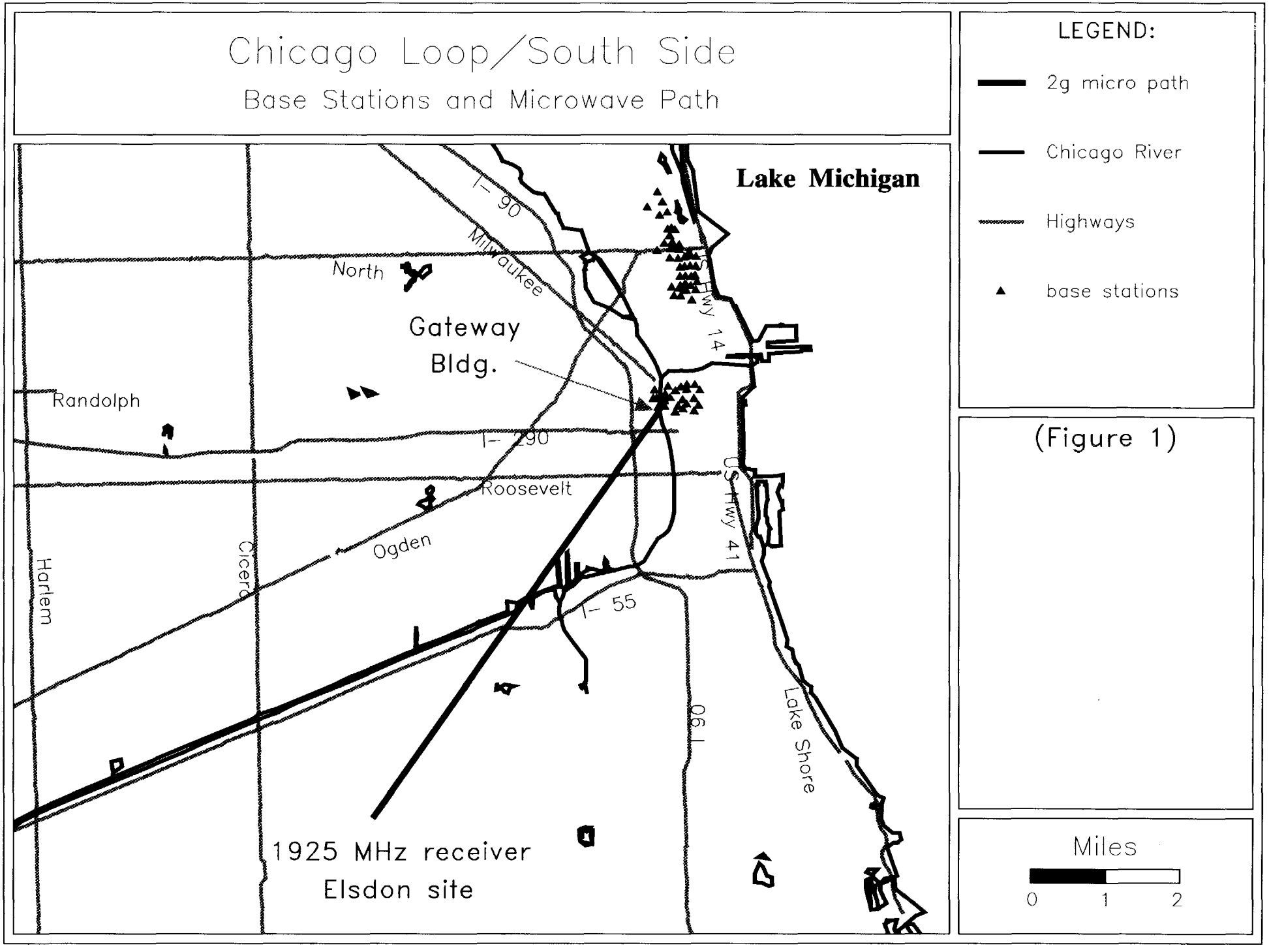

Chicago Loop/South Side
Base Stations and Microwave Path
Lake Michigan
I- 90
Milwaukee
North
Gateway
Bldg.
Randolph
I- 290
Roosevelt
Ogden
Cicero
Harlem
I- 55
US Hwy 14
US Hwy 41
I-90
Lake Shore
1925 MHz receiver
Elsdon site
LEGEND:
2g micro path
Chicago River
Highways
base stations
(Figure 1)
Miles
0
1
2

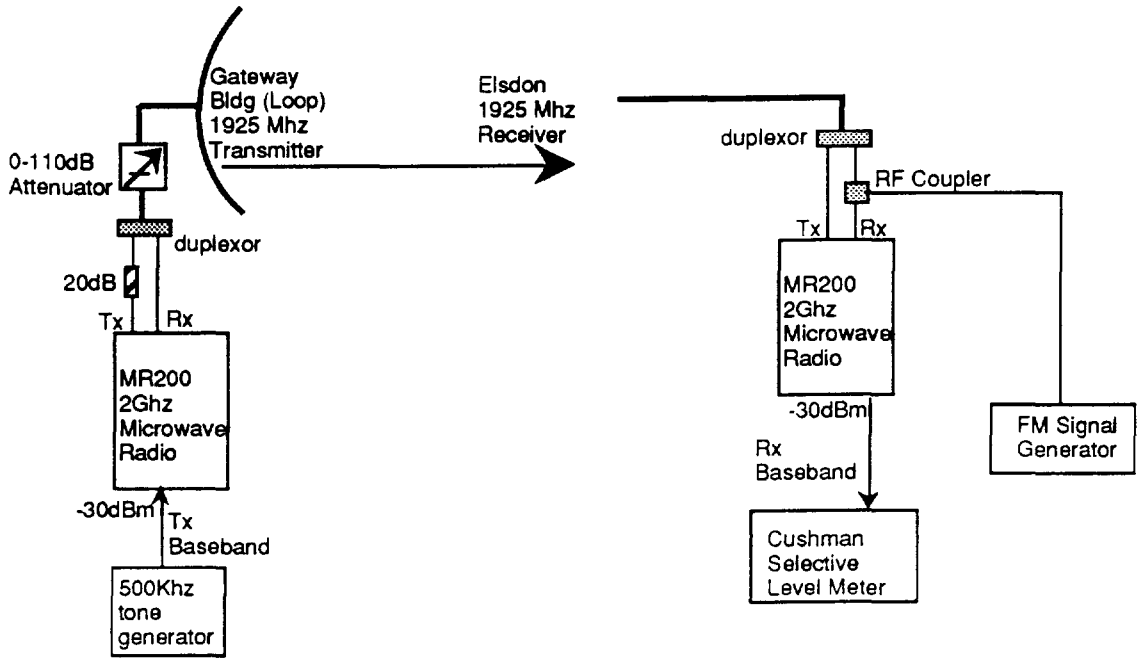
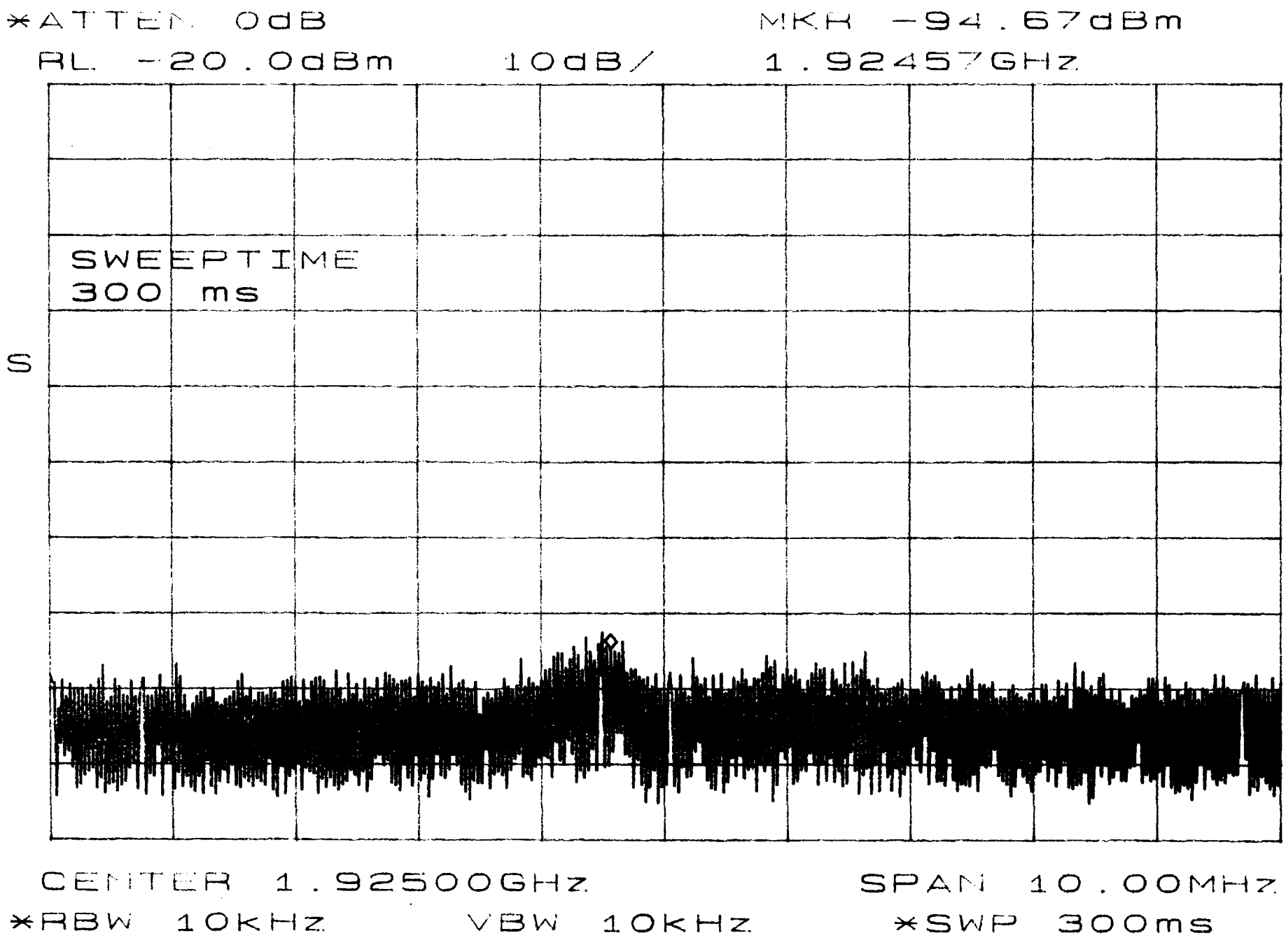
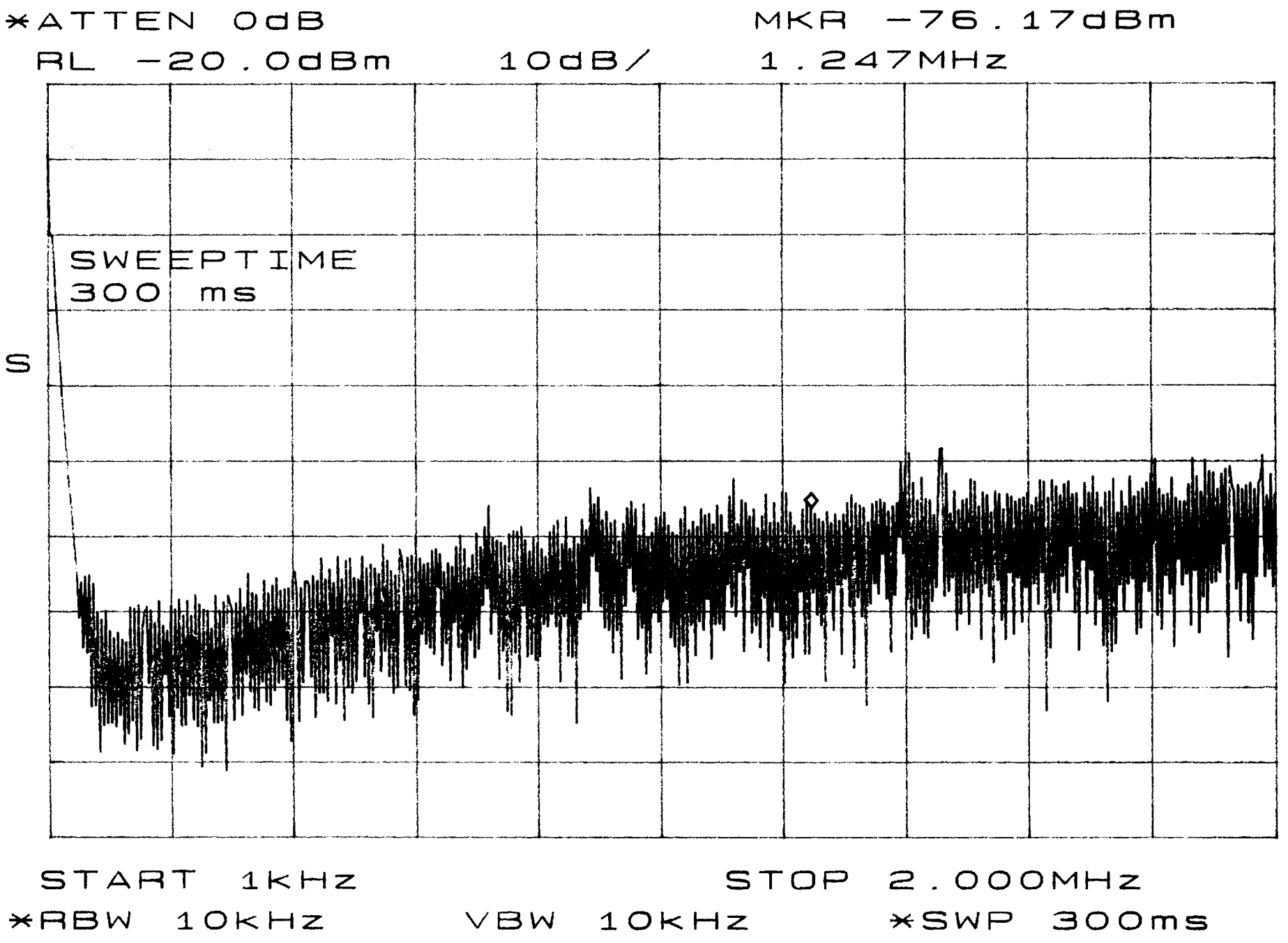


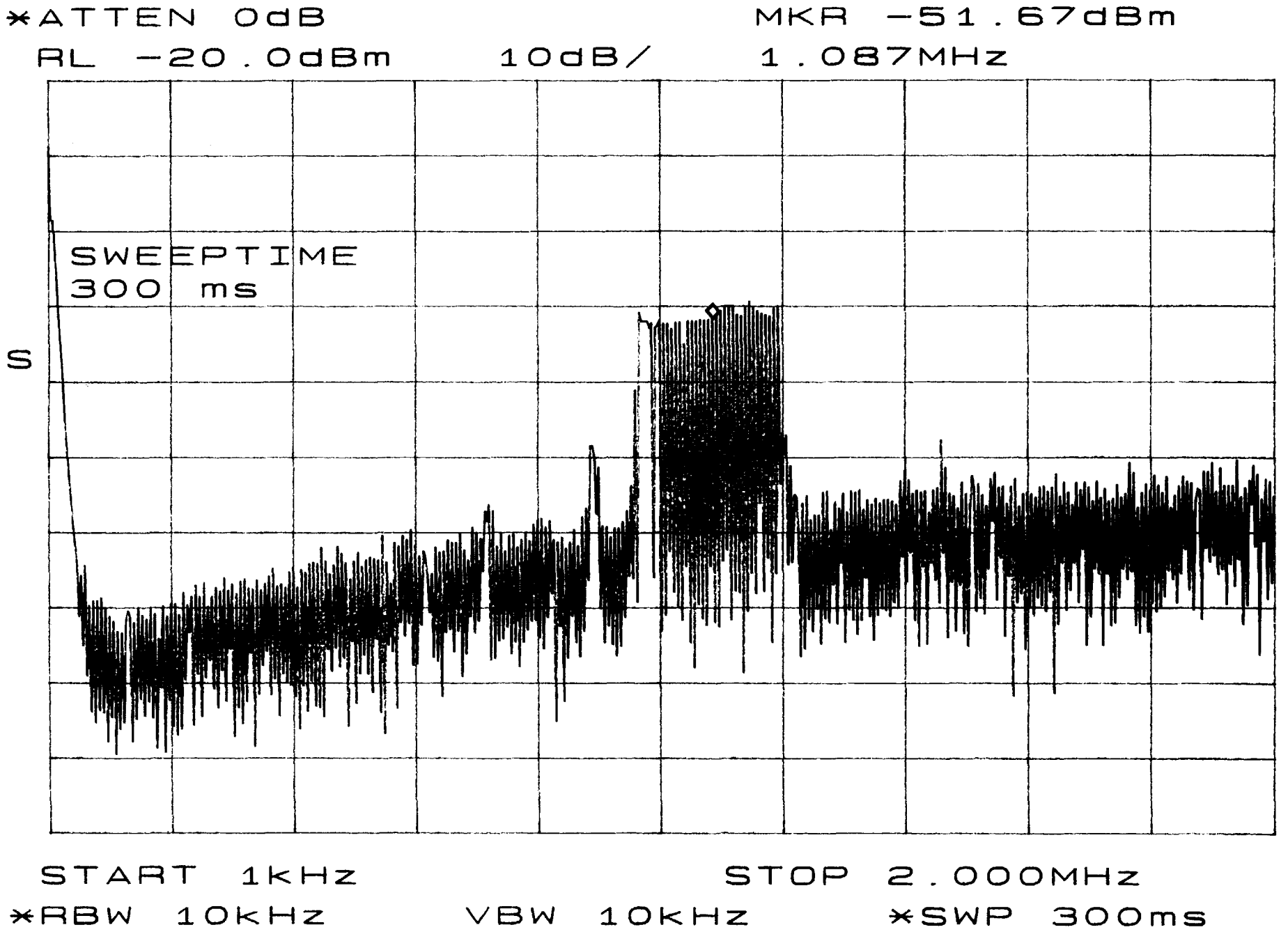
Fig.2 Set Up for PCS Interference onto Microwave


*ATTEN 0dB
MKR -94.67dBm
RL -20.0dBm
10dB/
1.92457GHz
SWEEPTIME
300 ms
S
CENTER 1.92500GHz
SPAN 10.00MHz
*RBW 10kHz
VBW 10kHz
*SWP 300ms

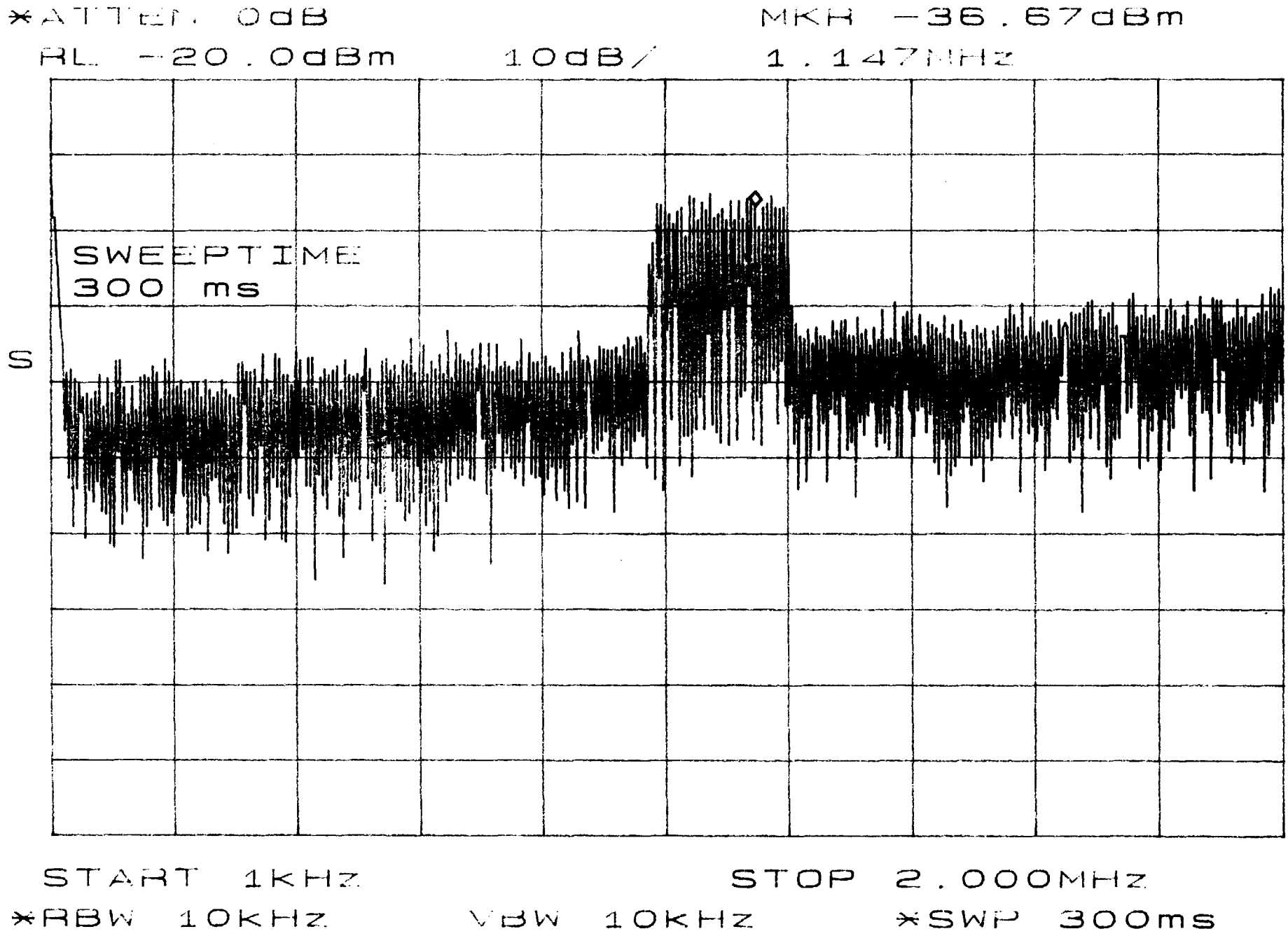
Plot 1


*ATTEN 0dB
MKR -76.17dBm
RL -20.0dBm
10dB/
1.247MHz
SWEEPTIME
300 ms
S
START 1kHz
STOP 2.000MHz
*RBW 10kHz
VBW 10kHz
*SWP 300ms

Plot 2


*ATTEN 0dB
MKR -51.67dBm
RL -20.0dBm
10dB/
1.087MHz
SWEEPTIME
300 ms
S
START 1kHz
STOP 2.000MHz
*RBW 10kHz
VBW 10kHz
*SWP 300ms

Plot 3


*ATTEN. 0dB
MKR -36.67dBm
RL -20.0dBm
10dB/
1.147MHz
SWEEPTIME
300 ms
S
START 1KHz
STOP 2.000MHz
*RBW 10KHz
VBW 10KHz
*SWP 300ms

Plot 4

Appendix 2

Transition Methodology

taken from

Chicago Spectrum Transition Study

completed by

Comsearch

Transition Methodology

The 6540 - 6870 MHz allocation was selected to be the transition band due to the following considerations:

- Bandwidth and channel capacity at 6.7 GHz are consistent with 1.9 GHz.
- The 6.7 GHz band supports short, medium, and long haul systems.
- Eligibility requirements at 6.7 GHz are consistent with 1.9 GHz.
- Stringent interference protection criteria for 6.7 GHz are specified in FCC Part 94.63 and Telecommunications Industries Association Bulletin 10-E.
- Mature technology and manufacturer support exists for the 6.7 GHz band as evidenced by the 8,300 paths in service.

The population of 1.9 GHz paths within a 35 mile radius of metropolitan Chicago was overlaid on the existing 6.7 GHz microwave environment. This plot represented the environment for conducting the migration simulation. This plot also enabled the establishment of an optimal 6.7 Ghz high/low frequency assignment.

All 1.9 GHz paths within the simulation boundary were translated into typical 6.7 GHz paths by using the parameters defined below:

- The geographical coordinates and ground elevations are identical to the existing 1.9 GHz paths.
- Transmission line loss values are identical based upon similarities of attenuation characteristics (variance of 0.6 dB/100ft) between foam dielectric coaxial cable and elliptical waveguide commonly used in the 1.9 GHz and 6.7 GHz bands, respectively.
- In order to satisfy FCC effective radiated power limitations, paths shorter than 10.6 miles (17 km) required attenuation in transmitter power.
- Antenna Criteria

  - Standard parabolic antennas with a minimum diameter of eight feet were implemented for all of the paths to satisfy off-beam radiation suppression requirements (Standard A) per FCC Rule Part 94.75.

  - Typical antenna performance characteristics (gain and discrimination) were derived from radiation pattern envelopes supplied by various manufacturers.

- Radio Criteria

  - The migrated paths at 6.7 GHz were coordinated with the same modulation (analog or digital) and, where possible, the same channel loading as the 1.9 GHz paths. On paths where the existing 1.9 GHz loading would violate the FCC minimum loading requirements at 6.7 GHz, 300 channel loading was used.

  * NOTE: For paths carrying a capacity of less than or equal to 120 analog channels, an alternate band with smaller channelized bandwidth requirements should be investigated to avoid inefficient use of the spectrum.

  - Typical equipment/radio specifications were derived from FCC technical standards and various radio manufacturers' filter characteristics and threshold-to-interference requirements. The threshold and filter performance characteristics are typical values within 3 dB of worst-case.

  See **Exhibit 1** for analog transmitter/receiver radio characteristics.
  See **Exhibit 2** for digital transmitter/receiver radio characteristics.

- Reliability Criteria

  - Reliability calculations were performed on the 1.9 GHz paths using the existing path parameters.

  - Reliability calculations were performed on the 6.7 GHz migrated paths using the previously defined parameters.

  - A per path reliability comparison/analysis was then conducted. No system modifications on the paths were necessary to improve reliability when <u>at least</u> one of the following two requirements were satisfied:

  (1) 2-way unavailability (sec/yr) @ 6.7 GHz $\leq$ 2-way unavailability @ 1.9 GHz + 100 sec/yr

  (2) 2-way reliability (unavailability sec/yr) @ 6.7 GHz $\leq$ 99.99990% (31.536 sec/yr)

  If the above criteria were not satisfied, modifications to path parameters were implemented.

  * NOTE: The effect of attenuation of the microwave signal due to rainfall or snow along the path is a function of a number of variables including the frequency band, the size and shape of the drops, and the distribution of rain along the path. The effect on bands of 8 GHz or lower, however, is so small as to be insignificant when compared to other types of fading. As a result, rain attenuation was <u>not</u> addressed in this study.

Exhibit 1

6.7 GHz Analog Radio Specifications

General:

Frequency Range: 6.525 - 6.875 GHz
Channel Capacity: 300, 480, 600
Modulation: FM

T/R Separation (same path): 160 MHz
Minimum T/R Separation (same path): 80 MHz
Minimum T/R Separation (co-site): 40 MHz (Analog-Analog)
50 MHz (Analog-Digital)

Transmitter:

Transmitter Power Output (Antenna Port): +31.0 dBm
Frequency Stability: ± 0.001%

Receiver:

IF Frequency: 70 MHz
RF Filter Bandwidth: 30 MHz
Receiver Overload: -27 dBm

Channel Capacity	Emission Designator	Threshold (dBm)	IF Bandwidth (MHz)
300	5,000 F9	-87.8	10.0
300	10,000 F9	-91.0	18.0/14.0
480	10,000 F9	-85.0	18.0/14.0
600	10,000 F9	-81.0	18.0/14.0

IF Filter Selectivity:

5 MHz Emission Bandwidth Radio:

Frequency Separation (MHz)	5	10	15	20
Selectivity (dB) 10 MHz IF Filter	3	18	14	15

10 MHz Emission Bandwidth Radio:

Frequency Separation (MHz)	5	10	15	20
Selectivity (dB) 18 MHz IF Filter	0	4	14	30
Selectivity (dB) 14 MHz IF Filter Refers to Upgraded Filter	0	25	25	37

Exhibit 2

6.7 GHz Digital Radio Specifications

General:

Frequency Range: 6.525 - 6.875 GHz
Emission Bandwidth: 5 MHz, 10 MHz
Channel Capacity: 8 DS1 (5 MHz Bandwidth)
28 DS1 (10 MHz Bandwidth)

Standard T/R Separation (same path): 160 MHz
Minimum T/R Separation (same path): 80 MHz
Minimum T/R Separation (co-site): 50 MHz (Digital-Digital)
50 MHz (Analog-Digital)

Transmitter:

Transmitter Power Output: 31.0 dBm (10 MHz Bandwidth)
Transmitter Power Output: 31.0 dBm (5 MHz Bandwidth)
R-value: 30.0 dBm
Frequency Stability: ± 0.001%
Transmitter Emitted Spectrum: Complies with FCC Part 94.71

Receiver:

5 MHz Bandwidth:

Threshold $10^{-6}/10^{-3}$ BER: -79.0/-84.0 dBm

Frequency Separation (MHz)	0	5
Threshold-to-Interference (T/I) dB	25	-15

10 MHz Bandwidth:

Threshold $10^{-6}/10^{-3}$ BER: -74.0/-77.0 dBm

Frequency Separation (MHz)	0	5	10	20
T/I values like signal (dB)	38	29	20	2
T/I values CW signal (dB)	38	28	-10	-20

- Interference Prediction and Resolution

  - Telecommunications Industry Association Bulletin 10-E interference prediction methods and FCC Part 94.63 interference avoidance criteria were used in analyzing interference scenarios between the transitioned 6.7 GHz paths and the existing 6.7 GHz environment.

  - The primary objective of interference resolution was to determine the total number of interference-free frequencies on transitioned 6.7 GHz paths while minimizing changes of the prescribed transition parameters and maintaining comparable reliability as outlined previously.

  - An additional analysis was conducted in order to assign specific frequencies which are compatible with both migrated paths and the existing 6.7 GHz microwave environment.

  - The priority in resolving predicted interference between transitioned and existing 6.7 GHz paths are listed below:

    1. Free space loss
    2. Antenna discrimination and cross-polarization
    3. Transmitter attenuation for transitioned path
    4. Filter upgrade for transitioned path
    5. Antenna upgrade for transitioned path
    6. Combinations of the above

  - As each transitioned 6.7 GHz path was assigned frequencies, it became part of the environment (along with existing 6.7 GHz systems) considered in conducting interference analysis and frequency assignment for subsequent transitioned paths.